

## **Iowa DNR New Wastewater Technology Assessment No. 09-02**

**Process Description:** AdvanTex Treatment Systems (manufactured by Orenco Systems, Inc.) Secondary treatment and ammonia nitrogen reduction processes

### **STATEMENT:**

Small scale treatment facilities capable of secondary treatment and secondary treatment with nitrification of wastes enabling effluent to meet varying levels of ammonia nitrogen limits is a challenge for small communities. Many communities are faced with NPDES permit limits of low single-digit ammonia nitrogen values. End-of-pipe limits in the range of 1mg/l (summer) and 2.7 – 5.8 mg/l (winter) are not uncommon results of current water quality standards in Iowa. Other applications require only secondary treatment or have ammonia nitrogen limits in higher ranges (> 5.8 mg/l winter).

To accomplish ammonia nitrogen effluent limits which are end-of-pipe limits (limits that are essentially the same as those required by state water quality standards in the discharge receiving stream), Orenco Systems, Inc. has proposed a two-stage system to enhance the nitrification capabilities of the AdvanTex systems for treating small municipal systems with primarily domestic wastewater only, no industrial or significant commercial loads.

Iowa's Wastewater Facility Design Standards do not adequately address the AdvanTex type of fixed film process specifically, therefore approvals are done as provided in section 14.4.3 "Required Engineering Data for New Process Evaluation". This assessment in addition to the applicable design standards will provide guidance to designers for DNR approval based on current empirical information relative to capabilities of the process in various applications. This document is not a design standard but is an indication of what may be considered acceptable for DNR approval. Future information may require modification.

The DNR recognizes the importance of feasible alternatives. This process was evaluated for technical capability to be compliant rather than affordability.

### **EVALUATION:**

Orenco has proposed a two-stage approach for process control purposes to accomplish the low ammonia nitrogen values (end-of-pipe limits 1 to 5.8 mg/l). No data or information is yet available from operating two-stage systems treating domestic wastewater. In a two stage system, both stages are AdvanTex fabric filter treatment processes. Stage 1 has the same basic target concentrations as prior-approved systems; stage 2 would be designed as a tertiary nitrification phase. Recirculation tanks follow each stage. Since intermediate clarification is not proposed between stages, the process is considered a single stage for applicability purposes of Wastewater Design Standards (specifically section 14.5.2.3).

The installations from which data are available documenting the capability to provide nitrification are single-stage systems. The data and other studies of single-stage systems have been reviewed. Generally, two-stage systems will be designed based on loading

experience for the single stage systems that are accomplishing nitrification to low levels. Since there are no data presented for “two-stage” systems treating domestic wastewater, the most applicable data for single stage operating systems that provide nitrification will be evaluated for comparable tertiary treatment situations.

DNR has evaluated plant loading conditions considered critical to attain necessary performance.

### **DESIGN LOADING CONCLUSIONS:**

This will summarize the loading condition considered necessary for reliable operations to meet various ranges of treatment. The DNR will review for approval proposed projects that meet the following loading requirements as minimums with the most restrictive loading criteria governing. Proposals varying from these loadings will be evaluated case-by-case based on appropriate supportive data and information. Future empirical data and information may allow adjustment of these design factors.

Treatment categories for typical domestic strength wastewater:

- A. Secondary treatment with final disposal by non-discharging methods (land application or subsurface disposal).
- B. Secondary treatment with nitrification limits greater than 2.8 mg/l summer and 5.8 mg/l in colder months (greater than end-of-pipe limits).
- C. Secondary treatment with nitrification limits 5.8 mg/l or less in any month (end-of-pipe limits).

The following loading rates will be considered:

- Hydraulic Loading Rate - gallons per day per square foot (gpd/ft<sup>2</sup>) of media surface, using AWW design flow (for new systems, 100 gallons per capita per day minimum).
- Organic Loading Rate – Peak day pounds BOD<sub>5</sub> per day per square foot (lbs/day/ft<sup>2</sup>) of media surface, using acceptable waste characteristics (for new systems with typical domestic waste, 0.17 lbs. per day per capita; when a significant number of users use food grinders, this may increase to 0.22 lbs. per capita per day).
- Ammonia Nitrogen Loading Rate – Peak day pounds NH<sub>3</sub>-N (= TKN) per day per square foot (lbs/day/ft<sup>2</sup>) of media surface, using acceptable waste characteristics (for new systems with typical domestic waste, 0.04 lbs. per day per capita) It shall be assumed that all of the influent TKN is converted to ammonia nitrogen.

### **Design expectations:**

#### **Category A –**

- Primary treatment is provided
- Use Orenco Manual for loading rates
- Hydraulic Loading Rate = 25 gpd/ft<sup>2</sup>
- Organic Loading Rate = 0.04 lbs. BOD<sub>5</sub>/d/ft<sup>2</sup>

Unit sizing based on most restrictive loading criteria

**Category B –**

- Hydraulic Loading Rate (without recirculation) = 18 gpd/ft<sup>2</sup>
- Organic Loading Rate = 0.03 lbs. BOD<sub>5</sub>/d/ft<sup>2</sup>
- Ammonia Nitrogen Loading Rate = 0.006 lbs. TKN/day/ft<sup>2</sup>

Unit sizing based on most restrictive loading criteria.

In addition:

- Primary tank (preceding treatment) total volume required = 4 x AWW  
Provided by individual septic tanks, a tank at a central site, or a combination.
- Recirculation tank = 100% of AWW
- Recirculation rate based on AWW = 4:1 minimum

**Category C –**

- Hydraulic Loading Rate = 12 gpd/ft<sup>2</sup>
- Organic Loading Rate = 0.02 lbs. BOD<sub>5</sub>/day/ft<sup>2</sup>
- Ammonia Nitrogen Loading Rate = 0.003 lbs. TKN/day/ft<sup>2</sup>

Unit sizing based on most restrictive loading criteria. Loading rates are plant overall rates without regard to stage.

In addition:

- Primary tank (preceding treatment) total volume required = 4 x AWW  
Provided by individual septic tanks, a tank at a central site or a combination.
- Recirculation tank (following stage 1) = 80% of AWW (minimum)
- Recirculation or polishing tank (following stage 2) = 20% AWW (minimum)
- Recirculation rate based on AWW: first stage = 4:1 minimum; second stage = 2:1 minimum

**For Categories A, B & C –**

- Due to Iowa's cold climate, R-13 insulation of unit sidewalls and lids
- Frost heave protection
- Piping protected below frost line or by insulation or heat trace
- Pod ventilation – warm air ventilation will be needed during cold months to maintain an incoming air temperature of 5° C. Calculations should show how this expectation will be met.

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